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# Ventilation

## Contents



## Supplements



* Revised.

## Definitions

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| **dust** | An air suspension of small, solid particles. |
| **toxic contaminant** | Airborne substance that is poisonous. |
| **vapor** | The gaseous form of substances that are normally solid or liquid at ambient temperatures. |
| **ventilation** | The application of regulated air movements to control atmospheric environment in a defined location. Includes natural or dilution ventilation and mechanical ventilation, such as heating, ventilating, and air-conditioning (HVAC) systems and local exhaust systems. |

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# Ventilation

## 12.01 Introduction

The primary objectives of ventilation are

- To control toxic and radioactive particulates, gases, and vapors to a level such that exposure to employees and the public is kept as low as reasonably achievable (ALARA).
- To ensure that any toxic contaminants generated in the work area, when released to the environment, are reduced to less than maximum allowable concentration limits prescribed by regulatory agencies (see Supplement 12.01 of this manual).
- To reduce airborne concentrations of dust and vapor to below explosive or flammable levels.
- To promote occupant comfort and suppress odor as needed in appropriate work areas.

All ventilation installations shall meet or exceed the requirements of the references listed in Section 12.04 of this chapter.

## 12.02 Responsibilities

Achieving the above objectives requires the coordination of various departments, groups, and individuals.

### New and Modified Facilities

Responsibilities during each phase of new construction or modification of a facility are listed below:

**Design Requirements.** If a hazardous ventilation situation is identified in a safety evaluation, as described in Chapter 2 of this manual, facility management shall consult with Hazards Control to establish the facility's ventilation design requirements.

**Engineering and Construction.** Plant Engineering shall provide plans, drawings, and specifications to Hazards Control and the Environmental Protection Department for review before construction and equipment procurement to ensure that (1) the design is consistent with the established design requirements, (2) the need for stack monitoring, air permits, or exemptions is evaluated, (3) necessary system monitoring instruments and test ports are provided, (4) the system's air intake and exhaust are compatible with surrounding facilities, and (5) a plan is provided for evaluating special equipment.

**Performance Acceptance Test.** After installation of the ventilation system but before use, Plant Engineering shall conduct performance tests of the system. Hazards Control shall verify that the system conforms with the design requirement before it can be considered acceptable. The level of verification will depend on the complexity of the system and the potential hazards involved. Systems containing fume hoods, glove boxes, and high-efficiency particulate air (HEPA) filters shall be tested using only procedures and personnel approved by Hazards Control. Special types of air-cleaning and energy-recovery equipment (such as scrubbers, cyclones, and heat exchangers) may require evaluation after installation, as determined by Hazards Control. Results of the performance tests shall be documented and kept by the facility management for future reference.

### Existing Facilities

The responsibilities for maintaining the ventilation systems of existing facilities to conform with design requirements are listed below:

**Surveillance.** Programmatic users are responsible for ensuring that Hazards Control establishes schedules for and conducts periodic inspections and tests of ventilation systems having local exhausters, fume hoods, glove boxes, HEPA filters, and air-cleaning devices. Hazards Control shall notify the responsible facility management of any system upgrading, maintenance, or repair work that is required.

**Maintenance.** Facility management shall coordinate normal maintenance and repair directly with Plant Engineering. Facility management shall ensure that operation of the ventilation system conforms to the design requirement. Facility management shall routinely verify operation of their ventilation systems.

**System Failure.** If a ventilation system used for control of radioactive, carcinogenic, or toxic material fails, all operations in the area served by that system shall be suspended immediately unless

other emergency procedures are approved. The responsible facility manager shall notify Hazards Control and request guidance in mitigating any hazardous situation and in determining the most effective means of restoring the system.

## 12.03 Ventilation Systems

### Normal Systems

Methods of providing healthful and comfortable indoor environments for offices, auditoriums, and light work areas are described in Ref. 1. The referenced standard includes a ventilation rate procedure and an indoor air-quality procedure for achieving an acceptable indoor environment. The ventilation rate procedure controls the indoor air quality by prescribing the volumetric rate of outdoor air required per person for a variety of indoor spaces. The indoor air-quality procedure specifies the maximum permissible concentrations of certain notable contaminants for indoor air.

### Specialized Systems

Specialized ventilation systems must be provided for work areas subject to excessive heat or in which the atmosphere can be contaminated by flammable or explosive vapor or by toxic, carcinogenic, or radioactive material. The major ventilation methods normally used to control these health hazards are described below. Air permits may be needed.

**Dilution Ventilation.** This method involves the dilution of contaminated air with uncontaminated air to reduce the hazardous contaminant or vapor to an acceptable level. Application of dilution ventilation is limited to controlling small quantities of low-toxicity contaminants and is generally not useful for controlling aerosols.

**Local Exhaust.** This method is designed to capture or entrain air contaminants at or near their source before the contaminant can be dispersed into the work area. Three general types of hoods are used in local exhaust systems:

- Capturing hoods (e.g., exhausters for welding and machine tools and exhaust slots for open tanks), which by means of high-velocity airflow draw contaminants into the hoods.
- Fume hoods and glove boxes, which enclose the source and prevent the contaminants from escaping. (For detailed information, see Supplement 12.03.)
- Receiving or canopy hoods, which are positioned to capture contaminants from a source generally involving heated processes. Canopy hoods are not recommended for controlling hazardous materials. Proposed use of these hoods shall have the approval of the Industrial Hygiene Group of Hazards Control.

### Replacement Air Systems

Replacement or makeup air shall be supplied to replace air that is removed from a facility by exhaust systems. Depending on the building requirements, the volume of the outside air supply could be more than, equal to, or less than the exhaust volume. The replacement air shall be introduced in such a manner as to enhance contaminant control and occupant comfort.

Recirculation of air used in ventilated areas in which there is the potential for carcinogenic or radioactive materials to be released into the atmosphere is not permitted unless evaluated and approved by Hazards Control. Recirculation of air to control toxic materials must be approved by Hazards Control. The intake for the replacement air system shall be located to prevent reentry of contaminants from its own exhaust systems or other sources (see Ref. 2, Section II, Chapter 14).

### Air-Cleaning Systems

Air-cleaning devices are used to reduce contaminants from effluents to allowable limits before being discharged to the environment. Filters are normally employed to remove particulates, and carbon adsorbent is used to remove gases and vapors. The most efficient air cleaner for particulates is a HEPA filter. Other cleaning devices, such as electrostatic precipitators, cyclones, scrubbers, incinerators, and dust filters, may be used depending on the type, nature, and concentration of the contaminants in the effluent. Consult Hazards Control for proper application of HEPA filters and other air-cleaning devices. For additional information on air-cleaning devices, see Refs. 2 through 8 and Supplement 12.05.

### Exhaust Stacks

The levels of contaminants released through stacks shall be kept as low as practicable. Methods for evaluating operational discharges, stack dilution, and environmental dispersion are presented in Supplement 12.01. Air monitoring for toxic or radioactive materials may be required. The Environmental Guidance Division (ext. 2-5167) of the Environmental Protection Department will provide information and requirements for this subject.

## 12.04 References


1. *Ventilation for Acceptable Indoor Air Quality*, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Standard 62-1989 (1989).

2. *ASHRAE Handbook. Fundamentals* (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta, GA, latest edition).

3. *ASHRAE Handbook. Systems* (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta, GA, latest edition).

4. *ASHRAE Handbook. Equipment* (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta, GA, latest edition).

5. *ASHRAE Handbook. Applications* (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta, GA, latest edition).

6. *Industrial Ventilation. A Manual of Recommended Practice* (American Conference of Governmental Industrial Hygienists, Cincinnati, OH, latest edition).

7. "General Design Criteria," U.S. Department of Energy, Washington, DC, Order 6430.1A (April 6, 1989).

8. C. A. Burchsted, A. B. Fuller, and J. E. Kahn, *Nuclear Air Cleaning Handbook*, U.S. Government Printing Office, Washington, DC, ERDA 76-21 (1979).